6. GROUNDWATER PROGRAMS

6.1 SUMMARY

Groundwater monitoring at DOE/PORTS is required by legal agreements with Ohio EPA and U.S. EPA and DOE Orders. More than 400 monitoring wells are used to track the flow of groundwater and to identify and measure groundwater contaminants. Groundwater programs also include on-site surface water monitoring and residential water supply monitoring. The contaminated groundwater plumes present at PORTS did not change significantly in 1999.

6.2 INTRODUCTION

Groundwater is used as a domestic, municipal, and industrial water supply in the vicinity of DOE/ PORTS. Most municipal and industrial water supplies in Pike County are developed from the Scioto River Valley buried aquifer. Domestic (household) water supplies are developed from sand and/or gravel deposits, tributaries to the Scioto River Valley aquifer, or fractures in bedrock. Groundwater beneath PORTS is not used as a domestic, municipal, or industrial water supply and contaminants in the groundwater beneath PORTS do not affect the quality of the water in the Scioto River Valley buried aquifer.

The PORTS reservation is the largest industrial user of water in the vicinity and obtains its water from three water supply well fields that are next to the Scioto River south of Piketon. The wells tap the Scioto River Valley buried aquifer. Total groundwater production averages 13 million gallons per day for the entire site, including USEC activities.

Groundwater monitoring includes several activities. Monitoring wells are used to obtain information about groundwater. When the level of water, or groundwater elevation, is measured in a number of wells over a short period of time, the groundwater elevations, combined with information about the subsurface soil, can be used to estimate the rate and direction of groundwater flow. The rate and direction of groundwater flow can be used to predict the movement of contaminants in the groundwater and to develop ways to control or remediate groundwater contamination. Samples of water are also collected from groundwater monitoring wells and analyzed to obtain information about contaminants and naturally-occurring compounds in the groundwater.

6.3 GROUNDWATER MONITORING AT DOE/PORTS

Groundwater water monitoring at PORTS was initiated in the 1980s. Groundwater monitoring has been conducted in response to regulatory requirements from state and/or federal regulations, regulatory documents prepared by DOE/PORTS, legal agreements between DOE and Ohio EPA or U.S. EPA, and DOE Orders. Groundwater monitoring at DOE/PORTS includes RCRA hazardous waste units, solid waste disposal units, and RCRA Corrective Action Program units.

Because of these numerous regulatory programs, DOE/PORTS developed the *Integrated Groundwater Monitoring Plan* to minimize the potential for confusion in interpreting requirements and to maximize resources for collecting the data needed for sound decision making. The *Integrated Groundwater Monitoring Plan* was designed to establish all groundwater monitoring requirements for PORTS and has been reviewed and approved by Ohio EPA. Prior to April 1999, groundwater monitoring

at PORTS was performed under the varying programs and requirements applicable to each groundwater monitoring area. On April 1, 1999, the *Integrated Groundwater Monitoring Plan* became the implementing document for groundwater monitoring at PORTS. Therefore, this Annual Environmental Report includes data collected under the *Integrated Groundwater Monitoring Plan* and first quarter 1999 data collected under previous program requirements.

Additional groundwater monitoring is completed to meet DOE Order requirements. Exit pathway monitoring assesses the effect of DOE/PORTS on regional groundwater quality and quantity. Baseline monitoring is conducted to establish background data for use in assessing the effect of DOE/PORTS operations on the groundwater. DOE Orders are also the basis for the radiological monitoring of groundwater at PORTS.

Two aquifers, or underground areas that contain significant amounts of water, are present at PORTS. These aquifers are called the Gallia and Berea. The Gallia is the uppermost aquifer, or closest to the ground surface, and contains most of the groundwater contamination at PORTS. The Berea aquifer is deeper than the Gallia and is usually separated from the Gallia by material that limits the movement of groundwater from the Gallia to the Berea.

Several areas of groundwater contamination have been identified at PORTS. Groundwater contamination consists of volatile organic compounds, primarily trichloroethene, and radionuclides such as uranium and technetium. In general, groundwater monitoring results for 1999 indicate that:

- Groundwater flow directions have remained generally the same, although the rate of flow was slower in many areas in 1999, possibly due to the lack of precipitation.

- Contaminants appear to be contained within the reservation's boundaries.

- The concentration of contaminants and the lateral extent of plume boundaries did not significantly increase in 1999.

The *1999 Annual Groundwater Monitoring Report* provides further details on the groundwater plumes at DOE/PORTS, specific monitoring well identifications, and analytical results for monitoring wells.

This chapter also includes information on the groundwater treatment facilities at PORTS. These facilities receive contaminated groundwater from the groundwater monitoring areas and treat the water prior to discharge through the DOE/PORTS permitted outfalls.

6.4 GROUNDWATER MONITORING AREAS

Prior to implementation of the *Integrated Groundwater Monitoring Plan*, routine groundwater monitoring was performed at six RCRA hazardous waste units, three solid waste units, and two RCRA Corrective Action Program units. With implementation of the *Integrated Groundwater Monitoring Plan*, these units were consolidated into eight groundwater monitoring areas within the four quadrants of the site designated by the RCRA Corrective Action Program. These areas (see Fig. 6.1) are:

- X-749 Contaminated Materials Disposal Facility/X-120 Old Training Facility/Peter Kiewit Landfill (formerly the X-749 Contaminated Materials Storage Yard and X-749B Peter Kiewit Landfill),

Fig. 6.1. Groundwater monitoring areas at PORTS.

- Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility (formerly the X-231B Southwest Oil Biodegradation Plot and X-749A Classified Materials Disposal Facility,)
- Quadrant II Groundwater Investigative Area (formerly the X-701C Neutralization Pit),
- X-701B Holding Pond,
- X-616 Chromium Sludge Surface Impoundments,
- X-740 Hazardous Waste Storage Facility,
- X-611A Former Lime Sludge Lagoons, and
- X-735 Landfills (formerly the X-735 RCRA Landfill and the X-735 Industrial Solid Waste Landfill).

The *Integrated Groundwater Monitoring Plan* also contains requirements for (1) surface water monitoring in creeks and drainage ditches at PORTS that receive groundwater discharge, and (2) residential water supply monitoring.

In general, samples are collected from wells (or surface water locations) at each area listed above and are analyzed for metals, volatile organic compounds, and radiological constituents. Table 6.1 lists the analytical requirements for each groundwater monitoring area and other monitoring programs described in this chapter. In general, PORTS compares constituents detected in the groundwater to standards called preliminary remediation goals to assess the potential for each constituent to affect human health and the environment. The preliminary remediation goals have been determined as part of the RCRA Corrective Action Program at PORTS. Preliminary remediation goals are based on naturally occurring concentrations of some constituents, on risk-based numbers calculated by the EPA, or are determined through a site-specific risk assessment. Data for the X-749A Classified Materials Disposal Facility (part of the Quadrant I Groundwater Investigative Area) and the X-735 Landfills are also statistically evaluated to determine whether the areas have impacted groundwater.

6.4.1 X-749 Contaminated Materials Storage Facility/X-120 Old Training Facility/Peter Kiewit Landfill

In the southernmost portion of PORTS, groundwater concerns focus on three contaminant sources: the X-749 Contaminated Materials Disposal Facility (both north and south portions), the X-120 Old Training Facility, and the Peter Kiewit (PK) Landfill. Prior to implementation of the *Integrated Groundwater Monitoring Plan,* monitoring in this area focused on the X-749 unit.

6.4.1.1 X-749 Contaminated Materials Disposal Facility

The X-749 Contaminated Materials Disposal Facility is located in the south-central section of the facility. The landfill covers approximately 7.5 acres and was built in an area of highest elevation within the southern half of PORTS. The landfill operated from 1955 to 1990, during which time buried wastes were generally contained in metal drums or other containers that were compatible with the waste.

The landfill is divided into a northern portion and southern portion. The northern portion is approximately 200,000 square ft in size and contains waste contaminated with industrial solvents, waste oils from plant compressors and pumps, sludges that were classified as hazardous, and low-level radioactive materials. The southern portion is approximately 130,000 square ft and contains non-hazardous, low-level radioactive scrap materials.

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS

Monitoring Area or Program	Analytes	
X-749/X-120/PK Landfill[a]		
X-749/X-120 plume	volatile organic compounds[b]	chloride
	technetium-99	sulfate
	total uranium	total metals[d]: Ca, Fe, Mg, K, Na
	alkalinity	transuranics[d,e]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu
PK Landfill	volatile organic compounds[b]	total metals[d]: As, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Ni, K, Se, Na, V, Zn
	technetium-99	
	total uranium	
	% uranium-235	fluoride
	alkalinity	mercury
	chloride	Arochlor-1260
	sulfate	
Quadrant I Groundwater Investigative Area[a]		
X-231B plume	volatile organic compounds[b]	chloride
	technetium-99	sulfate
	total uranium	total metals[d]: Ca, Fe, Mg, K, Na
	alkalinity	transuranics[d,e]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu
X-749A Classified Materials Disposal Facility	volatile organic compounds[c]	total metals[d]: Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn
	gross alpha, gross beta	
	technetium-99	
	total uranium	
	alkalinity	
	chloride	ammonia
	sulfate	chemical oxygen demand
	nitrite	total dissolved solids
	nitrate	turbidity
Quadrant II Groundwater Investigative Area[a]	volatile organic compounds[b]	chloride
	technetium-99	sulfate
	total uranium	total metals[d]: Ca, Fe, Mg, K, Na
	alkalinity	transuranics[d,e]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu, ^{230}Th
X-701B Holding Pond[a]	volatile organic compounds[b]	chloride
	technetium-99	sulfate
	total uranium	total metals[d]: Ca, Fe, Mg, K, Na
	alkalinity	transuranics[d,e]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu, ^{230}Th
X-616 Chromium Sludge Surface Impoundments	volatile organic compounds[b]	chloride
	gross alpha, gross beta	sulfate
	technetium-99	total metals[d]: Ca, Fe, Mg, K, Na, Ba, Cd, Cr, Pb, Mn, Ni, Sb, Tl
	total uranium	
	alkalinity	

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS (continued)

Monitoring Area or Program	Analytes		
X-740 Hazardous Waste Storage Facility[a]	volatile organic compounds[b]	chloride	
	technetium-99	sulfate	
	total uranium	total metals[d]:	Ca, Fe, Mg, K, Na
	alkalinity		
X-611A Former Lime Sludge Lagoons	total metals[d]:		
X-735 Landfills	volatile organic compounds[c]	total metals[d]:	Sb, As, Ba, Be, Cd,
	gross alpha, gross beta		Ca, Cr, Co, Cu, Fe,
	technetium-99		Pb, Mg, Mn, Ni, K,
	total uranium		Se, Ag, Na, Tl, V,
	alkalinity		Zn
	chloride		
	sulfate	ammonia	
	nitrite	chemical oxygen demand	
	nitrate	total dissolved solids	
		turbidity	
Surface Water	volatile organic compounds[b]	chloride	
	technetium-99	sulfate	
	total uranium	total metals[d]:	Ca, Fe, Mg, K, Na
	alkalinity	transuranics[d]:	^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu
Residential Water Supply	volatile organic compounds[b]	Chloride	
	technetium-99	Sulfate	
	total uranium	total metals[d]:	Ca, Fe, Mg, K, Na
	alkalinity	transuranics[d]:	^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu
Exit Pathway and Baseline	volatile organic compounds[b]	chloride	
	technetium-99	sulfate	
	total uranium	total metals[d]:	Ca, Fe, Mg, K, Na
	alkalinity		

[a] Selected well(s) in this area are sampled once every two years for a comprehensive list of over 200 potential contaminants (40 CFR Part 264 Appendix IX – Appendix to OAC Rule 3745-54-98).

[b] Acetone, benzene, bromodichloromethane, bromoform, carbon disulfide, carbon tetrachloride, chlorobenzene, chloroethane, chloroform, dibromochloromethane, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, bromomethane, chloromethane, methylene chloride, 2-butanone (methyl ethyl ketone), 4-methyl-2-pentanone (methyl isobutyl ketone), 1,1,2,2-tetrachloroethane, tetrachloroethene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethene, trichloroethene, trichlorofluoromethane (CFC-11), vinyl chloride, 1,3 (1,4)-dimethylbenzene (xylenes).

[c] VOCs listed in footnote 2 plus the following: acrylonitrile, bromochloromethane, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, trans-1,4-dichloro-2-butene, 1,2-dichloropropane, cis-1,3-dichloropropene, trans-1,3-dichloropropene, 2-hexanone (methyl butyl ketone), dibromomethane, iodomethane, styrene, 1,1,1,2-tetrachloroethane, 1,2,3-trichloropropane, and vinyl acetate.

[d] Appendix C lists the symbols for metals and transuranic radionuclides.

[e] Samples from selected wells at this area are analyzed for these parameters

Closure of the X-749 landfill included installation of (1) a multimedia cap, (2) a slurry wall along the north side and northwest corner of X-749, and (3) subsurface groundwater drains on the northern half of the east side and the southwest corner, including one groundwater extraction well within each of the groundwater drains. The slurry wall and subsurface drains extend down to bedrock. Groundwater from the subsurface drains is treated on site and discharged in accordance with the DOE/PORTS NPDES permit.

The leading edge of the contaminated groundwater plume emanating from the X-749 landfill has been approaching the southern boundary of the PORTS reservation. In 1995, a subsurface diversion wall was completed across a portion of this southern boundary. The diversion wall is designed to inhibit migration of the plume off plant property prior to the implementation of a final remedial measure.

Three wells monitor the subsurface diversion wall at the leading edge of the groundwater plume. These wells are sampled quarterly. Twenty-one additional wells (19 monitoring wells and 2 extraction wells) are sampled semiannually to monitor the X-749 plume. Twenty additional wells are sampled annually or biennially to monitor both the X-749 and the X-120 plumes. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.1.2 X-120 Old Training Facility

The X-120 Old Training Facility covered an area of approximately 11.5 acres near the present-day XT-847 building. The X-120 facility, which no longer exists, included a machine shop, metal shop, paint shop, and several warehouses used during the construction of PORTS in the 1950s. The shops may have used solvents and various other materials; disposal practices of these solvents are unknown.

Groundwater in the vicinity of this facility contains primarily trichloroethene. The upgradient portion of the X-120 plume co-mingles with a portion of the X-749 plume; however, downgradient the X-120 plume migrates independently to the southwest. In 1996, a horizontal well was installed along the approximate axis of the X-120 plume. This well passively transmits contaminated groundwater by gravity drainage to the X-625 Groundwater Treatment Facility.

Three wells are sampled semiannually to monitor the plume associated with the X-120 area. Twenty additional wells are sampled annually or biennially to monitor both the X-749 and the X-120 plumes. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.1.3 PK Landfill

The PK Landfill is located west of Big Run Creek just south of the X-230K Holding Pond. The landfill, which began operations in 1952, was used as a salvage yard, burn pit, and trash area during the construction of PORTS. After the initial construction, the disposal site was operated as a sanitary landfill until 1968, when soil was graded over the site and the area was seeded with native grasses. No records exist that characterize the material in the landfill.

During site investigations, intermittent seeps were observed emanating from the PK Landfill into Big Run Creek. In 1993, sampling was conducted at three of the seeps and at Big Run Creek approximately 40 ft downstream of the seeps. Sample results indicated that the seeps contained vinyl chloride; however, no vinyl chloride was detected in Big Run Creek.

In 1994, a portion of Big Run Creek was relocated approximately 50 ft to the east. A groundwater collection system was installed in the old creek channel to capture the seeps emanating from the landfill. A second collection system was constructed on the southeastern boundary to contain the groundwater

plume migrating toward Big Run Creek from the southern portion of the PK landfill in 1997. A cap was constructed over the landfill in 1998.

Ten wells were sampled quarterly from the fourth quarter of 1998 through the third quarter of 1999 to monitor this area. Beginning in the fourth quarter of 1999, sampling at the wells takes place semiannually. Two sumps that collect groundwater from the plume are sampled quarterly. Table 6.1 lists the analytical parameters for the wells and sumps in this area.

6.4.1.4 Monitoring results for the X-749/X-120/PK Landfill in 1999

Contaminated groundwater plumes are associated with the X-749/X-120/PK Landfill groundwater monitoring area (see Fig. 6.2). The most extensive and most concentrated constituents associated with the X-749/X-120 plume are volatile organic compounds, particularly trichloroethene and trichloroethane. Remediation of these constituents may be required as part of the RCRA Corrective Action Program.

In 1999, the X-120 and X-749 plumes became less separated based on the detection of trichloroethene in the sample collected from well X120-09G. No other significant changes to the plume boundaries were identified in 1999.

Inorganics (metals) and radiological constituents (uranium and technetium) have also been detected in the groundwater beneath the X-749 area. Remediation of these constituents may be required as part of the RCRA Corrective Action Program at the X-749.

Some of the wells associated with the PK Landfill also appear to be contaminated with low levels of volatile organic compounds, but usually at concentrations below preliminary remediation goals. However, vinyl chloride was detected in two wells in 1999 above its preliminary remediation goal. Remediation of these constituents may be required as part of the RCRA Corrective Action Program.

6.4.2 Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility

In the northern portion of Quadrant I, groundwater concerns focus on two areas: the Quadrant I Groundwater Investigative Area and the X-749A Classified Materials Disposal Facility. The X-231B Southwest Oil Biodegradation Plot is a part of the Quadrant I Groundwater Investigative Area and was monitored prior to implementation of the *Integrated Groundwater Monitoring Plan*. The X-749A was also monitored prior to implementation of the *Integrated Groundwater Monitoring Plan* under requirements for solid waste landfills.

6.4.2.1 X-231B Southwest Oil Biodegradation Plot

The X-231B Southwest Oil Biodegradation Plot was used from 1976 to 1983 for land application of contaminated oil/solvent mixtures generated from the enrichment process and maintenance activities. The X-231B area is located west of the X-600 Steam Plant, and consisted of two disposal plots, each surrounded by an elevated soil berm, which were periodically fertilized and disked to enhance aeration and promote biological degradation of waste oil. The X-231B area was not operated as a RCRA-regulated land treatment unit. Since ceasing operation in 1983, these plots have been remediated to remove volatile organic compound contamination present in the soil and an interim cap has been installed over the area.

Fig. 6.2. Trichloroethene-contaminated Gallia groundwater plume at the X-749/X-120/PK Landfill (1999).

Three groundwater extraction wells were installed in the Gallia in 1991 as part of the X-231B interim remedial measure. These wells have a cumulative pumping rate of about 9 gal/minute. The wells are located south (downgradient) of the X-231B area. The extracted groundwater is treated at the X-622 Groundwater Treatment Facility. In 1994, soils above the groundwater were treated using *in situ* thermal enhanced vapor extraction to remove volatile organic compounds. Approximately 80% of the volatile organic compounds present in the soils were removed by this treatment.

Fifteen wells are sampled semiannually as part of the monitoring program for the Quadrant I Groundwater Investigative Area. An additional 20 wells are sampled annually or biennially. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.2.2 X-749A Classified Materials Disposal Facility

The 6-acre X-749A Classified Materials Disposal Facility operated from 1953 through 1988 for the disposal of wastes classified under the Atomic Energy Act. Potential contaminants include PCBs, asbestos, radionuclides, and industrial waste. Closure of the landfill, completed in 1994, included the construction of a multilayer cap and the installation of a drainage system to collect surface water runoff. The drainage system discharges via a USEC NPDES-permitted outfall.

Eight wells are sampled semiannually as part of the monitoring program for the X-749A landfill. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.2.3 Monitoring results for the Quadrant I Groundwater Investigative Area/X-749A in 1999

A contaminated groundwater plume consisting primarily of trichloroethene is associated with the Quadrant I Groundwater Investigative Area (see Fig. 6.3). Other volatile organic compounds are also present in the plume. Inorganics (metals), uranium, and technetium are also present, but the concentrations of these constituents are below the established preliminary remediation goals and therefore do not require remediation as part of the RCRA Corrective Action Program.

Analytical results from the two 1999 sampling events at the X-749A landfill, associated statistical analyses, and comparisons of 1999 data to historical data indicate that there was not a significant change in the indicator parameters evaluated at this area in 1999. These results indicate that leachate has not been released from this unit to the groundwater.

6.4.3 Quadrant II Groundwater Investigative Area

In the western portion of Quadrant II, groundwater concerns are focused on the Quadrant II Groundwater Investigative Area. The X-701C Neutralization Pit is part of the Quadrant II Groundwater Investigative Area and was monitored prior to implementation of the *Integrated Groundwater Monitoring Plan.*

The X-701C Neutralization Pit is an 18-ft-deep 25-ft by 25-ft open-topped neutralization pit that received process effluents and basement sump wastewater from the X-700 Chemical Cleaning Facility from approximately 1953 to 1988, when the X-701C was deactivated. Waste received included acid and alkali solutions, and rinse water contaminated with trichloroethene and/or trichloroethane from metal cleaning operations. The X-701C Neutralization Pit is located within a trichloroethene plume centered around the X-700 and X-705 buildings.

Fig. 6.3. Trichloroethene-contaminated Gallia groundwater plume at the Quadrant I Groundwater Investigative Area (1999).

The natural groundwater flow direction in this area is to the east toward Little Beaver Creek. However, the groundwater flow pattern has been changed in this area by using sump pumps in the basements of the X-700 and X-705 buildings. The use of the sump pumps means that the groundwater plume in this area does not spread but flows toward the sumps where it is collected and then treated at the X-622 Groundwater Treatment Facility.

Eight wells are sampled annually as part of the monitoring program for this area. An additional 16 wells are sampled biennially. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.3.1 Monitoring results for the Quadrant II Groundwater Investigative Area in 1999

A contaminated groundwater plume consisting primarily of trichloroethene is associated with the Quadrant II Groundwater Investigative Area (see Fig. 6.4). The extent of this groundwater plume did not change between 1998 and 1999. Numerous other volatile organics were also detected within the plume. Inorganics (metals), uranium, and technetium were also detected in 1999, but the concentrations of these constituents are below the established preliminary remediation goals. Thorium-230 was also detected in samples collected from two wells in 1999 at concentrations less than 1 picocurie/liter.

6.4.4 X-701B Holding Pond

In the eastern portion of Quadrant II, groundwater concerns focus on three areas: the X-701B Holding Pond, the X-230J7 Holding Pond, and the X-744Y Waste Storage Yard.

The X-701B Holding Pond was used from the beginning of plant operations in 1954 until November 1988. The pond was designed for neutralization and settlement of acid waste from several sources. Trichloroethane and trichloroethene were also discharged to the pond. Two sludge retention basins were located west of the holding pond. The X-230J7 Holding Ponds received wastewater from the X-701B Holding Pond.

The X-744Y Storage Yard is approximately 15 acres and surrounds the X-744G Bulk Storage Building. This area is one of the RCRA hazardous waste management units considered an "integrated unit" in the 1999 Director's Final Findings and Orders and is therefore included in the RCRA Corrective Action Program (see Chap. 2, Sect. 2.3.2.1).

A contaminated groundwater plume extends from the X-701B Holding Pond to Little Beaver Creek. Three groundwater extraction wells were installed southeast of X-701B as part of the ongoing RCRA closure of the unit. These wells were designed to intercept contaminated groundwater emanating from the holding pond area before it could join the existing groundwater contaminant plume. Extracted groundwater is processed at the X-623 Groundwater Treatment Facility. This facility also processes water recovered from a shallow sump in the bottom of the X-701B Holding Pond. Two groundwater interceptor trenches (French drains) are used to intercept trichloroethene-contaminated groundwater emanating from X-701B. The X-237 Groundwater Collection System has significantly reduced trichloroethene migration into Little Beaver Creek. The 660-foot-long primary trench has two extraction wells completed in the backfill, and a 440-foot-long secondary trench intersects the primary trench. The extracted groundwater is treated at the X-624 Groundwater Treatment Facility.

Fifteen wells are sampled semiannually as part of the monitoring program for this area. An additional 17 wells are sampled annually or biennially. Table 6.1 lists the analytical parameters for the wells in this area.

Fig. 6.4. Trichloroethene-contaminated Gallia groundwater plume at the Quadrant II Groundwater Investigative Area (1999).

6.4.4.1 Monitoring results for the X-701B Holding Pond in 1999

The trichloroethene plume at this groundwater monitoring area contains the highest concentrations of trichloroethene measured in groundwater at PORTS. Numerous other volatile organics are also detected in samples collected from the monitoring wells in this area. The plume did not change significantly from 1998 to 1999 (see Fig. 6.5).

A second trichloroethene plume at the X-701B monitoring area was identified in 1998 and continued to be detected in 1999 in the X-744Y Storage Yard area. This apparently isolated and crescent-shaped plume is believed to be separate from and unrelated to the X-701B Holding Pond plume. Flow data for this new plume indicates the flow direction is to the northeast, or toward the main X-701B plume. This flow data and historical sampling data support the theory that this new plume is unrelated to the primary X-701B plume. Inorganics (metals) and radiological constituents (uranium and technetium-99) are also detected in the groundwater in this area. These constituents are being evaluated as part of a special study and may require remediation as part of the RCRA Corrective Action Program.

6.4.5 X-616 Chromium Sludge Surface Impoundments

The X-616 Chromium Sludge Surface Impoundments are two unlined surface impoundments used from 1976 to 1985 for storage of sludge generated by the treatment of water from the PORTS process cooling system. A corrosion inhibitor containing chromium was used in the cooling water system. Sludge containing chromium was produced by the water treatment system and was pumped into and stored in the X-616 impoundments. The sludge was removed from the impoundments and remediated as an interim action in 1990 and 1991. The unit was certified closed in 1993. Six wells are sampled annually and 10 wells are sampled biennially as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.5.1 Monitoring results for the X-616 Chromium Sludge Surface Impoundments in 1999

Chromium is of special concern at the X-616 because of the previous use of the area. Chromium was only detected in samples from 4 of the 16 wells in 1999. Of these wells, only the concentration of chromium in well X616-05G exceeded the preliminary remediation goal for chromium of 100 Fg/L. Fig. 6.6 shows the concentrations of chromium in wells at the X-616.

Volatile organic compounds were detected at low levels in samples collected from four wells at this area. The only volatile organic detected above its preliminary remediation goal was trichloroethene. Remediation of constituents detected above preliminary remediation goals may be required as part of the RCRA Corrective Action Program.

6.4.6 X-740 Hazardous Waste Storage Facility

The X-740 Hazardous Waste Storage Facility, which is located on the western half of PORTS south of the X-530A Switchyard, consists of two hazardous waste management units: the X-740 Waste Storage Facility and the X-740 Hazardous Waste Storage Tank (sump) located within the building. The X-740 facility operated from 1983 until 1991; the tank/sump was only operated until 1990. The units were initially identified as hazardous waste management units in 1991. The unit underwent closure, and closure certification was approved by Ohio EPA in 1998.

Constructed in 1982, the facility consists of a diked concrete pad, a roof, corrugated steel siding on three sides, and a plastic windbreak on the fourth side. The unit is approximately 120-ft by 50-ft. During

Fig. 6.5. Trichloroethene-contaminated Gallia groundwater plume at the X-701B Holding Pond (1999).

Fig. 6.6. Chromium concentrations in groundwater at the X-616 Chromium Sludge Surface Impoundments (1999).

its period of operation, the facility was used as an inventory and staging facility for waste oil and waste solvents that were generated from various plant operational and maintenance activities. The drums were staged at the facility pending analysis of their contents and subsequent final disposition. Empty drums, resulting from combining partially full drums, were crushed in a hydraulic drum crusher located in the northwest corner of the X-740 building and then disposed of at the X-735 Landfill. The tank/sump was installed in 1986 and was used to collect residual waste oil and waste solvents from the drum crushing operation. No drainage system was associated with the tank/sump area.

Eleven wells are sampled semiannually as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.6.1 Monitoring results for the X-740 Hazardous Waste Storage Facility in 1999

A contaminated groundwater plume consisting primarily of trichloroethene is associated with the X-740 Hazardous Waste Storage Facility (see Fig. 6.7). The volatile organic compounds detected in 1999 were restricted to the previously defined plume perimeter. Remediation of these constituents is proceeding as part of the RCRA Corrective Action Program. Chap. 3 describes the phytoremediation project at the X-740 area.

Several metals and uranium were also detected in samples collected in 1999, but the concentrations of these constituents are below the established preliminary remediation goals.

6.4.7 X-611A Former Lime Sludge Lagoons

The X-611A Former Lime Sludge Lagoons are three adjacent unlined sludge retention lagoons constructed in 1954 and used for disposal of lime sludge waste from the site water treatment plant from 1954 to 1960. The lagoons, which had a capacity of approximately 295,000 cubic yards, cover a surface area of approximately 18 acres. The lagoons were constructed in a low-lying area that included Little Beaver Creek. As a result, approximately 1500 feet of Little Beaver Creek was relocated to a channel just east of the lagoons.

As part of the RCRA Corrective Action Program, a prairie habitat has been developed at this area by placing a soil cover over the north, middle, and south lagoons. A soil berm was also constructed outside the northern boundary of the north lagoon to facilitate shallow accumulation of water in this low-lying area. Six wells are sampled semiannually as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.7.1 Monitoring results for the X-611A Former Lime Sludge Lagoons in 1999

The six monitoring wells at X-611A (see Fig. 6.8) are sampled and analyzed for beryllium and chromium. Chromium was not detected in any of the wells in 1999. Beryllium has been detected in samples collected from four of the X-611A monitoring wells.

6.4.8 X-735 Landfills

Several distinct waste management units are contained within the X-735 Landfills area. The main units consist of the hazardous waste landfill, referred to as the X-735 Landfill (Northern Portion), and the X-735 Industrial Solid Waste Landfill. The X-735 Industrial Solid Waste Landfill includes the industrial solid waste cells, asbestos disposal cells, and the closed chromium sludge monocells A and B. The chromium sludge monocells contain a portion of the chromium sludge generated during the closure of the X-616 Chromium Sludge Surface Impoundments.

Fig. 6.7. Trichloroethene-contaminated Gallia groundwater plume at the X-740 Hazardous Waste Storage Facility (1999).

Fig. 6.8. Monitoring wells at the X-611A Former Lime Sludge Lagoons.

Initially, a total of 17.9 acres was approved by the Ohio EPA and Pike County Department of Health for landfill disposal of conventional solid wastes. The landfill began operation in 1981, and the original design of the facility included 15 cells for solid waste disposal. The term "cells" refers to sections of the landfill that outline the locations where trenches were constructed for material disposal. Waste disposal was accomplished by shallow land burial using the trench and fill method. Wastes were delivered to the landfill and unloaded near the active trench. The waste was then spread and compacted by a bulldozer and/or landfill compactor. Daily cover material (soil) was applied to the compacted solid waste at the end of each work day.

Previous PORTS investigations indicated that approximately 12,000 pounds of wipe rags contaminated with solvents had inadvertently been disposed in Cells 1 through 6 of the landfill. Historical data indicated that the wipe rags contaminated with solvents most likely contained methyl ethyl ketone, which was considered a hazardous waste. The contaminated rags were immediately removed from the solid waste stream by instituting new management controls to isolate contaminated rags as hazardous waste.

Waste disposal in Cells 1 through 6 ceased at the end of December 1991. Ohio EPA subsequently determined that Cells 1 through 6 required closure as a RCRA hazardous waste landfill. Consequently, this unit of the sanitary landfill was identified as the X-735 Landfill (Northern Portion). A buffer zone was left unexcavated to provide space for groundwater monitoring wells and a space between the RCRA landfill unit and the remaining southern portion, the X-735 Industrial Solid Waste Landfill. Routine groundwater monitoring has been conducted at the X-735 Landfills since 1991.

The industrial solid waste portion of the X-735 Landfills includes a solid waste section and an asbestos waste section. The X-735 Industrial Solid Waste Landfill, not including the chromium sludge monocells, encompasses a total area of approximately 4.1 acres. Operation of the X-735 Industrial Solid Waste Landfill ceased in 1997, and this portion of the landfill was capped in 1998.

The IGWMP integrates monitoring requirements for the hazardous and solid waste portions of the X-735 Landfills. Thirteen wells are sampled semiannually under the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.8.1 Monitoring results for the X-735 Landfills in 1999

Samples collected from wells at the X-735 Landfills were analyzed for volatile organic compounds in the fourth quarter of 1999. No volatile organic compounds were detected in any of the wells. Fig. 6.9 shows the well locations at this area.

In the fourth quarter of 1999, samples from X-735 wells were analyzed for antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, magnesium, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc. The former X-735 hazardous waste landfill wells were also analyzed for numerous metals in the first quarter of 1999. Of these metals, only antimony, arsenic, cobalt, and mercury were not detected in any well during 1999; all other metals were detected in at least one well.

Analytical data from X-735 monitoring wells were also statistically evaluated to determine whether releases from the X-735 unit have occurred. Results of the statistical evaluation for 1999 indicate that there have been no releases from the X-735 to the underlying groundwater.

Fig. 6.9. Monitoring wells at the X-735 Landfills.

6.4.9 Surface Water Monitoring

Surface water monitoring is conducted in conjunction with groundwater assessment monitoring to determine if contaminants present in groundwater are detected in surface water samples. Surface water is collected quarterly from 13 locations (see Fig. 6.10). The purpose for each surface water monitoring location is listed below:

- Little Beaver Creek and East Drainage Ditch sample locations LBC-SW01, LBC-SW02, and EDD-SW01 assess possible X-701B area plume groundwater discharges;

- Little Beaver Creek sample location LBC-SW03 assesses potential contamination from the X-611A Lime Sludge Lagoons;

- Big Run Creek sample locations BRC-SW01 and BRC-SW02 monitor for potential groundwater discharges related to the X-231B Southwest Oil Biodegradation Plot, the Quadrant I Groundwater Investigative Area plume, and the X-749/X-120/Peter Kiewit Landfill area plume, all of which discharge into the X-230K Holding Pond and Big Run Creek;

- The unnamed Southwestern Drainage Ditch is sampled at two locations, UND-SW01 and UND-SW02, to assess potential groundwater releases to this creek and the X-2230M Holding Pond from the X-749/X-120/Peter Kiewit Landfill area plume;

- The North Holding Pond sample locations NHP-SW01 and LBC-SW04 assess potential groundwater discharges from any unknown Quadrant IV sources; and

- The West Drainage Ditch sample locations WDD-SW01, WDD-SW02, and WDD-SW03 assess potential groundwater discharges from the X-616 area to the West Drainage Ditch and the X-2230N Holding Pond.

Table 6.1 lists the analytical parameters for the surface water sampling locations.

6.4.9.1 Monitoring results for surface water in 1999

No volatile organic compounds were detected at the surface water sampling locations in Big Run Creek, Little Beaver Creek, East Drainage Ditch, or North Holding Pond during 1999, with the exception of small amounts of chloroform and other trihalomethanes that are common residuals in treated chlorinated drinking water. These streams received such treated water. Trichloroethene has been detected regularly in samples collected from the unnamed Southwestern Drainage Ditch (UND-SW01, located inside the perimeter road) at low levels since 1990 and was detected in 1999 at 4 - 5 Fg/L.

Uranium occurs naturally in rocks and soil, which may account for the low uranium concentrations that were detected below preliminary remediation goals at many surface water sampling locations in 1999. Technetium-99 was detected in samples collected from the East Drainage Ditch (EDD-SW01) and Little Beaver Creek (LBC-SW01) in the first quarter of 1999, but was not detected at these locations or any other locations in any other quarter in 1999.

6.4.10 Residential Water Supply Monitoring

Routine monitoring of residential drinking water sources is completed at PORTS in accordance with the requirements of Section VIII of the September 1989 Consent Decree between the State of Ohio and

Fig. 6.10. Surface water monitoring locations.

DOE and the Residential Groundwater Monitoring Requirements contained in the *Integrated Groundwater Monitoring Plan.*

The purpose of the program is to determine whether residential drinking water sources have been adversely affected by plant operations. Although this program may provide an indication of contaminant transport off site, it should not be interpreted as an extension of the on-site groundwater monitoring program, which bears the responsibility for detection of contaminants and determining the rate and extent of contaminant movement. Data from this program will not be used in environmental investigations due to the lack of knowledge of how residential wells were constructed and due to the presence of various types of pumps (which may not be ideal equipment for sampling).

Five residential drinking water sources participating in the program (see Fig. 6.11) are sampled semiannually for the parameters listed in Table 6.1. The PORTS water supply is also sampled as part of this program. Sampling locations may be added or deleted as resident requests and program requirements dictate. Typically, sampling locations are deleted when a resident obtains a public water supply. Sampling locations are added upon request if there is a probable hydrogeologic connection between PORTS and the resident's water supply.

Sampling results for 1999 indicate that DOE/PORTS operations have not affected the PORTS water supply or residential water supplies sampled as part of this monitoring program.

6.5 DOE ORDER MONITORING PROGRAMS

The surveillance monitoring program at DOE/PORTS consists of exit pathway monitoring and baseline monitoring. Exit pathway monitoring assesses the effect of the facility on regional groundwater quality and quantity. Baseline monitoring is conducted to establish baseline data.

6.5.1 Exit Pathway Monitoring

Selected locations on local streams and drainage channels near the reservation boundary are sampling points of the exit pathway monitoring program because groundwater discharges to these surface waters. Monitoring wells near the reservation boundary are also used in the exit pathway monitoring program. Fig. 6.12 shows the sampling locations for exit pathway monitoring.

No volatile organic compounds, uranium, or technetium-99 were detected in the exit pathway monitoring wells in 1999. Trichloroethene and other compounds present in chlorinated drinking water were detected at surface water sampling points that are part of the exit pathway monitoring program. These results are discussed in Sect. 6.4.9.1.

6.5.2 Baseline Monitoring

Four well clusters, each composed of one well completed in the Gallia and one well completed in the Berea, are sampled annually to determine baseline water quality (Fig. 6.12). Sampling is conducted to provide a comparison between on-site wells and wells that represent background water quality.

6.6 GROUNDWATER TREATMENT FACILITIES

In 1999, a combined total of approximately 24.7 million gallons of contaminated water was treated at the X-622, X-622T, X-623, X-624, and X-625 Groundwater Treatment Facilities. Approximately 100

Fig. 6.11. Residential water supply monitoring locations.

Fig. 6.12. Exit pathway and baseline monitoring locations.

gallons of trichloroethene were removed from the groundwater. All processed water is discharged through NPDES outfalls before exiting PORTS. Facility information is summarized in Table 6.2.

Table 6.2. Summary of trichloroethene removed by DOE/PORTS groundwater treatment facilities in 1999

Facility	Gallons of water treated	Gallons of trichloroethene removed
X-622	7,600,000	1
X-622T	10,700,000	12
X-623	3,300,000	55
X-624	2,900,000	33
X-625	142,000	0.015

6.6.1 X-622 Groundwater Treatment Facility

Activated carbon and green sand filtration are used to treat water at the X-622 Groundwater Treatment Facility. This facility processes groundwater from the Quadrant I Groundwater Investigative Area and the X-749 Contaminated Materials Disposal Facility/X-120 Old Training Facility/Peter Kiewit Landfill groundwater collection systems. In 1999, the unit processed approximately 7.6 million gallons of groundwater, removing 1 gallon of trichloroethene from the water.

Water treated in the X-622 Groundwater Treatment Facility is released through DOE/PORTS NPDES Outfall 608. One sample of water from this outfall was analyzed for americium-241, neptunium-237, plutonium-238, and plutonium-239/240 in 1999. None of these constituents was detected in the sample.

6.6.2 X-622T Groundwater Treatment Facility

At the X-622T Groundwater Treatment Facility, activated carbon is used to treat contaminated groundwater from the X-700 and X-705 buildings. These buildings are located above the Quadrant II Groundwater Investigative Area plume, and contaminated groundwater is extracted from sumps located in the basement of each building. In 1999, approximately 10.7 million gallons of groundwater were processed, thereby removing 12 gallons of trichloroethene from the water.

Water treated in the X-622T Groundwater Treatment Facility is released through DOE/PORTS NPDES Outfall 611. One sample of water from this outfall was analyzed for americium-241, neptunium-237, plutonium-238, plutonium-239/240, and thorium-230 in 1999. None of these constituents was detected in the samples.

6.6.3 X-623 Groundwater Treatment Facility

The X-623 Groundwater Treatment Facility consists of an air stripper with offgas activated carbon filtration and aqueous-phase activated carbon filtration. The X-623 Groundwater Treatment Facility treats trichloroethene-contaminated groundwater from the X-701B Holding Pond and three groundwater extraction wells in the X-701B plume area. The facility treated approximately 3.3 million gallons of water in 1999, thereby removing 55 gallons of trichloroethene from the water.

Water treated in the X-623 Groundwater Treatment Facility is released through DOE/PORTS NPDES Outfall 610. One sample of water from this outfall was analyzed for americium-241, neptunium-237, plutonium-238, plutonium-239/240, and thorium-230 in 1999. None of these constituents was detected in the samples.

6.6.4 X-624 Groundwater Treatment Facility

At the X-624 Groundwater Treatment Facility, groundwater is treated via an air stripper with offgas activated carbon filtration and aqueous-phase activated carbon filtration. This facility processes trichloroethene-contaminated groundwater from the X-237 interceptor trench associated with the X-701B plume. The facility treated approximately 2.9 million gallons of water in 1999, thereby removing 33 gallons of trichloroethene from the water.

Water treated in the X-624 Groundwater Treatment Facility is released through DOE/PORTS NPDES Outfall 015. One sample of water from this outfall was analyzed for americium-241, neptunium-237, plutonium-238, plutonium-239/240, and thorium-230 in 1999. None of these constituents was detected in the samples.

6.6.5 X-625 Groundwater Treatment Facility

Groundwater is gravity-fed from a horizontal well associated with the X-749/X-120 groundwater plume to the X-625 Groundwater Treatment Facility. As part of an ongoing technology demonstration, water at this facility has been treated with various passive media such as iron filings. During 1999, iron filings were the primary media used for treatment. The water is further treated by being passed through activated carbon filtration prior to being discharged. In 1999, approximately 142,000 gallons of groundwater were treated, thereby removing 0.015 gallon of trichloroethene.

Water treated in the X-625 Groundwater Treatment Facility combines with other wastewaters and is released through DOE/PORTS NPDES Outfall 012. One sample of water from this outfall was analyzed for americium-241, neptunium-237, plutonium-238, and plutonium-239/240 in 1999. None of these constituents was detected in the samples.